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No. Hei 6[1994]-684

# SURFACE TREATMENT METHOD

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# SURFACE TREATMENT METHOD

[Hyomen shori hoho]

| | |
|---|---|
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[All amendments are incorporated into the translation.]

Claims

1. A surface treatment method characterized in that a surface treatment method utilizing irradiation of a laser is carried out in a liquid in order to prevent scattered substances from adhering to a material.

2. A surface treatment method characterized in that a surface treatment method utilizing irradiation of a laser is carried out in an electric field in order to prevent scattered substances from adhering to a material.

3. A surface treatment method characterized that in a surface treatment method utilizing irradiation of a laser is carried out in a magnetic field in order to prevent scattered substances from adhering to a material.

4. A surface treatment method characterized in that in a surface treatment method utilizing irradiation of a laser, a laser beam is irradiated in a vacuum while evacuating using a vacuum pump in order to prevent scattered substances from adhering to a material.

5. A surface treatment method characterized in that in a surface treatment method utilizing irradiation of a laser, control is performed so as to create an oxidative or reducing atmosphere around [the part] where the laser surface treatment is applied in order to remove scattered substances.

6. A surface treatment method characterized in that in a surface treatment method utilizing irradiation of a laser, the laser beam is irradiated downward in the vertical direction so as to let scattered substances drop downward in the vertical direction in order to avoid the scattered substances from adhering to the surface.

Detailed explanation of the invention

[0001]

Industrial application field

The present invention pertains to a surface treatment method for preventing scattered substances from adhering to a material in a laser surface treatment method.

[0002]

Prior art

In the case of a laser-based surface treatment method, particularly in a surface treatment method utilizing UV-ray irradiation, scattered substances adhere near the area where the laser beam is irradiated, so they need to be removed after the laser treatment. The adhered substances are particularly prominent when an organic material or a macromolecular material is used. The removal method predominantly involves rinsing in an organic solvent such as an alcohol; and since it is a liquid, a drying step is required after the adhered substances are removed. In addition, as another measure, a method in which thin films are pasted over the surface of a target material, surface treatment is applied to each film, and the films are peeled off subsequently in order to take care of the adhered substances on the films is available.

[0003]

Problems to be solved by the invention

However, in the case of the rinsing using the organic solvent of the conventional method for removing the adhered substances, because the target material to be abraded needs to be dried after the adhered substances are removed, the process gets complicated. In addition, the method in which films are pasted on the target material to be abraded is problematic in that the films are wasted, and the number of the steps ends up increasing.

[0004]

In order to solve the aforementioned problems, the purpose of the present invention is to present a surface treatment method for removing the scattered substances created by the laser abrasion in order to prevent them from adhering to the target material to be abraded.

[0005]

Means to solve the problems

In order to solve the aforementioned problems, the surface treatment method utilizing irradiation of a laser in the present invention is characterized in that said treatment is carried out in a liquid in order to prevent scattered substances from adhering to a material. It is also characterized in that [the treatment] is carried out in an electric field in order to prevent scattered substances from adhering to the material. In addition, it is characterized in that [the treatment] is carried out in a magnetic field in order to prevent scattered substances from adhering to the material. In addition, it is characterized in that the laser beam is irradiated in a vacuum while evacuating using a vacuum pump in order to prevent scattered substances from adhering to the material. In addition, it is characterized in that control is performed so as to create an oxidative or reducing atmosphere around [the part] where the laser surface treatment is applied in order to remove scattered substances. In addition, it is characterized in that the laser beam is irradiated downward in the vertical direction so as to let scattered substances drop downward in the vertical direction in order to avoid the scattered substances from adhering to the surface.

[0006]

Function

In the case of irradiation of a laser beam to an organic material made of macromolecules, scattered substances are likely to adhere near the part where the laser beam is irradiated. As a method for prevent the adhesion of said scattered substances, the scattered substances are dissolved into a liquid. In addition, the substances scattered by the irradiation of the laser beam are electrically charged. Therefore, the irradiation of the laser beam is carried out in an electric

field and a magnetic field in order to prevent their adhesion to the material. In addition, the laser beam is irradiated in an atmosphere in which the scattered substances are oxidized or reduced to a compound in order to prevent the adhesion. In addition, because the scattered substances collide with gaseous molecules in the air sometimes and adhere to the surface of the material, the irradiation is carried out in a vacuum in order to eliminate their adherence to the surface of the material. In addition, in order to prevent the scattered substances from dropping due to the collisions and the gravitational force, the laser beam is irradiated downward in the vertical direction so as to allow free fall of the substances. As described above, in the present invention, the substances scattered by the application of the laser beam can be removed without letting them adhere to the surface of the base material.

[0007]

Application examples

The present invention will be explained below based on application examples. A printed circuit metallic surface or a resin part (in this case, PGA (Pin Grid Array)) is used as the material.

Application Example 1

As shown in Figure 1, PGA 1 is immersed into solution 4 (in this case, an alcohol, an organic solvent, or water was used), and solution 4 is let flow. In terms of the amount of solution 4, it is sufficient as long as it covers the surface of the PGA 1 slightly, that is, 1 mm or less from the surface of PGA 1. Solution 4 is circulated inside of container 3 provided with window 3c through which excimer laser 5 penetrate. Excimer laser 5 passes inside of solution 4 after it penetrates window 3c and reaches the surface of PGA 1 for abrasion. At this time, the laser beam or the UV beam is absorbed into solution 4, so that a small amount of energy reaches the surface of PGA 1. Therefore, the irradiation energy is set higher in advance. In addition, because the beam is refracted at window 3c or inside of solution 4, the irradiation of the beam needs to be positioned vertically. Scattered substances 2 created through the abrasion are dissolved into solution 4. Here, 3a and 3b are an inlet and an outlet of container 3.

[0008]

Application Example 2

It has been known that in the case of abrasion of macromolecules using excimer laser 5, the surface of the target material to be abraded and the scattered substances are electrically charged. Therefore, scattered substances 2 during the abrasion can be trapped by mask electrode 6 when PGA 1 is inserted into an electric field. Figure 2 shows an outer appearance thereof. At this time, although the direction the laser beam is irradiated matches the direction of the electrode,

mask imaging method, which is popular in a machining method utilizing excimer laser 5, may be used effectively to used the electrode itself in place of the mask. In addition, when conduction is established between PGA 1 and electrode 7, the difference in potential between scattered substances 2 and the electrode is increased, so that the effect is further improved. In addition, the scattering (breaking of connections) during the abrasion becomes easier when PGA 1 itself has a potential. At this time, because the charged potential differs depending on the target material to be abraded, the potential needs to be changed for each material. For example, in the case of a polyamide, the surface potential increases by 1V or so as the laser beam is irradiated. Therefore, it is preferable that the potential of mask electrode 6 on the trapping side is a positive potential.

[0009]

Application Example 3

Like in the second application example, because the surface of the target material and the scattered substances are electrically charged during the macromolecular abrasion using the excimer laser, when the abrasion is carried out in a magnetic field, the scattered substances are bent by Lorentz force. Figure 3 shows an outer appearance thereof. In general, the direction of scattered substances 2 and the irradiating direction of excimer laser 5 are the same so as to block the laser beam. However, because the direction they are bent by the Lorentz force and the laser irradiation direction are different, absorption of the laser by scattered substances 2 is reduced, so that the laser can be utilized more effectively.

[0010]

Application Example 4

Figure 4 (a) shows a method in which excimer laser 5 is irradiated through window/lens 8b in a vacuum while evacuating using a vacuum pump for abrasion so as to discharge scattered substances 2 to the outside of chamber 8 through exhaust hole 8a in order to prevent them from adhering to PGA 1. Because laser-abraded scattered substances 2 collide with gaseous molecules in the air and adhere to the surface of PGA 1, the quantity of the colliding molecules is radically reduced in order to prevent the adhesion. In reality, as shown in (b), only the part of PGA 1 where excimer laser 5 is irradiated should be simply evacuated using small container 13 with lens 12 instead of placing PGA 1 in vacuum chamber 8.

[0011]

Application Example 5

Figure 5 shows a method in which the laser abrasion atmosphere is regulated so as to remove scattered substances 2 chemically. Gas 10 is injected into chamber 9 through inlet 9a and

discharged through outlet 9b. For example, when target material 14 to be abraded by irradiating excimer laser 5 is organic substances such as macromolecules, many of abraded scattered substances 2 have carbon[-carbon] linkage (C-C), carbon-hydrogen linkage (C-H), or carbon-oxygen linkage (C-O), which are chemical radicals. Therefore, when the atmosphere is turned into oxygen using gas 10 so as to create carbon-oxygen linkages (CO, $CO_2$), scattered substances 2 can be removed effectively. In addition, when target material 14 to be abraded is an oxide, for example, when it is CuO or $Cu_2O$, it is reduced by the abrasion as the atmosphere is controlled into hydrogen, and it becomes a simple metallic body.

[0012]

Application Example 6

As for the substances adhered during the laser abrasion in the atmosphere, many of the scattered substances abraded by the laser beam collide with gaseous molecules in the air and drop to adhere to the surface of the material. Therefore, in order to eliminate the dropping of the scattered substances, the laser is irradiated downward in the vertical direction so as to direct the scattered substances downwardly in order to prevent the adhesion of the scattered substances on PGA 1. Figure 6 shows an application example of the aforementioned method, wherein excimer laser 5 is irradiated from below. In this case, needless to say, it is preferable to carry it out in combination with the aforementioned another application example.

[0013]

Effect of the invention

As explained above, according to the surface treatment method of the present invention, the substances adhered to the target material to be abraded as a result of the laser abrasion can be eliminated, so that the surface condition of the target material prior to the abrasion treatment can be maintained.

Brief description of the figures

Figure 1 is a diagram for explaining the surface treatment method in a first application example of the present invention.

Figure 2 is a diagram for explaining the surface treatment method in a second application example of the present invention.

Figure 3 is a diagram for explaining the surface treatment method in a third application example of the present invention.

Figure 4 are diagrams for explaining the surface treatment method in a fourth application example of the present invention.

Figure 5 is a diagram for explaining the surface treatment method in a fifth application example of the present invention.

Figure 6 is a diagram for explaining the surface treatment method in a sixth application example of the present invention.

Explanation of symbols

| | |
|---|---|
| 1 | PGA |
| 2 | Scattered substance |
| 3 | Container |
| 3a | Inlet |
| 3b | Outlet |
| 3c | Window |
| 4 | Solution |
| 5 | Excimer laser |
| 6 | Mask electrode |
| 7 | Electrode |
| 8 | Chamber |
| 8a | Exhaust hole |
| 8b | Window/lens |
| 9 | Chamber |
| 9a | Inlet |
| 9b | Outlet |
| 10 | Gas |
| 12 | Lens |
| 13 | Small container |
| 14 | Target material to be abraded |

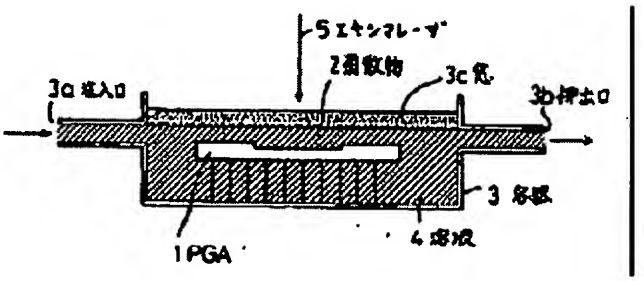


Figure 1

Key: 2 Scattered substance
3 Container

3a Inlet
3b Outlet
3c Window
4 Solution
5 Excimer laser

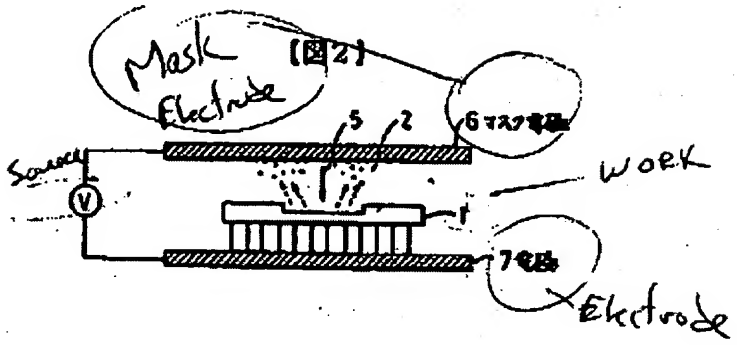


Figure 2

Key: 6 Mask electrode
7 Electrode

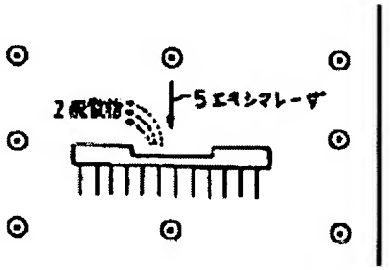


Figure 3

Key: 2 Scattered substance
5 Excimer laser

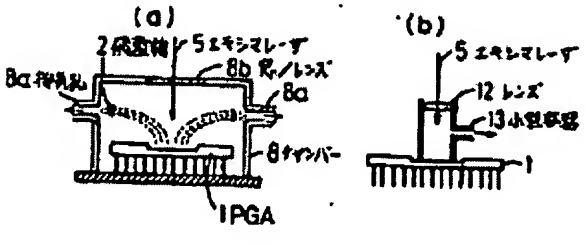


Figure 4

Key: 2 Scattered
5 Excimer laser

8 Chamber
8a Exhaust hole
8b Window/lens
12 Lens
13 Small container

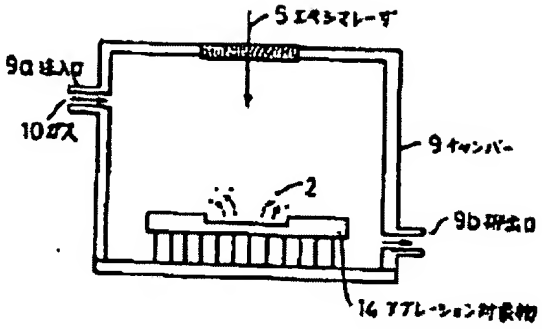


Figure 5

Key: 5 Excimer laser
9 Chamber
9a Inlet
9b Outlet
10 Gas
14 Target material to be abraded

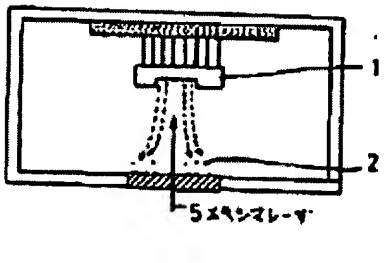


Figure 6

Key: 5 Excimer